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LOS ANGELES SCIENTIFIC CENTER REPORT NO. G320-2702

MARCH 1980

CRITERIA FOR DECOMPOSING AN INFORMATION SYSTEM INTO ITS SUBSYSTEMS FOR BUSINESS SYSTEMS PLANNING

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ABSTRACT

The paper discusses five main criteria for the construction of the subsystems of an information system, for Business Systems Planning (BSP). The criteria are flexibility, separability, comprehensibility, integrability and data usage and/or creation. Two procedures based on the data usage and/or creation criterion are described. These procedures can be used to determine the composition of each subsystem, keeping the other four criteria in focus. An application of the methodology to a sample of BSP data is discussed.

Introduction

Business Systems Planning (BSP) is a procedure for analyzing the information requirements of a business organization and developing an information systems architecture which will address those needs. In the analysis both top-down and bottom-up approaches are used. In the top-down or decision analysis method, the decisions of management are examined in order to identify the basic underlying information structure of the organization in terms of the decision-making activities of the management. The bottom-up approach looks at the information needs of the organization from the operational level. It is in essence an analysis of the organization's data needs at the operational level.

In a BSP study, the top-down approach is used to analyze the business objectives and the various processes or functions performed by the management of the various organizational units within the business. For the different levels of management to properly function in the execution of those processes under their control, certain information is needed. The information needed is in turn dependent on certain classes or types of data which are identified through the bottom-up technique. The information collected from the two approaches is later analyzed to determine what information systems architecture will best satisfy those needs.

The need for identifying the information subsystems of the organization is motivated by a desire to reduce the level and degree of complexity of the information system and also to maximize the independence among the subsystems. Moreover, in a BSP study, the problem of identifying the

subsystems of the organization's information system has been characterized as "somewhat a matter of judgement" [1]. Thus the subsystems which are proposed in a BSP study are usually somewhat arbitrary and depend on the collective intuition and experience of the team members involved in the study. Our objective in this paper is to minimize the effect of the subjective element and provide a more rational basis for deciding on the composition of the subsystems.

Decomposition Criteria:

Five main criteria are proposed which can be used to guide the construction of the various information subsystems which comprise the total information system of the business. An information subsystem is considered to comprise a set of business <u>functions</u> or <u>processes</u> which are interconnected together by the creation or usage of common <u>data</u>. In what follows, we will briefly discuss the role played by each criterion in the decomposition of the information system of a business.

* Flexibility - This deals with the ability of each subsystem to adapt itself to the information needs of the user community. In order for the information system to satisfy this criterion, it is imperative that each subsystem be flexible enough to respond to changing business conditions affecting it, without creating a need to modify any of the other subsystems. In this way the stability of each subsystem will be enhanced due to its ability to respond to various changes imposed on it both from inside and outside the business [3].

* Separability and Uniqueness - This criterion requires that the components of each subsystem must be separate and unique from the other subsystems so that each can be independently analyzed in detail. The condition is designed to greatly minimize the number of interconnections among subsystems. With the interconnections among the subsystems at the lowest possible level, the analysts will only then have to wrestle with the problem of comprehending the details of any one subsystem at a time. This will have a positive impact on the design and subsequent implementation of each subsystem. This requirement will also contribute to the stability of each subsystem because any changes or modifications necessitated by changing business conditions can be implemented without significantly impacting the other subsystems.

* Comprehensibility - Here we are concerned with the size and the degree of complexity of each subsystem. The intent of this criterion is to reduce the amount of detail that the system designers must comprehend for each subsystem identified. The motivation for this requirement is to ensure that each subsystem is of a manageable size so that it takes less time and effort not only to understand but also to design, implement and maintain. Finally the subsystems will be less prone to errors if each is better understood, designed and implemented.

* Integrability - The purpose of this condition is to ensure that each proposed subsystem is capable of being easily integrated with the other subsystems to achieve a fully integrated information system for the business. The importance of this criterion can be attributed to the fact that information systems in business organizations are without exception developed in stages. This criterion will thus ensure that clearly defined interfaces are specified among the subsystems to support the integration of the completed subsystems. The integrability condition will also enhance the stability of each subsystem by isolating or limiting the impact of potential sources of change upon the total information system [3].

* Process Data Creation and/or Usage Criterion - As previously stated, one of the main objectives of the BSP study is to group processes and data into major subsystems. In this way, the degree of interconnection between subsystems can be greatly minimized. However, in the construction of the subsystems, attention should be given to how data usage and/or creation will affect the choice of the processes which comprise any subsystem. This is important because the use of unneeded data produces dependencies among subsystems which otherwise should logically be unrelated [6]. This criterion will thus ensure that each subsystem will be composed of those business functions or processes which are strongly related in terms of common usage and/or creation of data. This should not be confused with the outmoded practice in software development in which the business processes or functions own the data they use and/or create within the subsystem.

The main interest in this approach to the construction of information subsystems, apart from minimizing the subjective element inherent in current BSP methods, is to enable the system designers to know which business functions or processes may be realized together as a single program component. This systematic approach to information system development permits parallel or sequential development of the individual subsystems as desired by management. Component design, testing, implementation and maintenance of the individual business functions or processes comprising each subsystem can be undertaken, thus making the subsystems less prone to errors. Also dependencies between any pair of subsystems can be held to the barest minimum which will necessitate that interfaces between the subsystems be clearly defined. The stability of each subsystem will also be enhanced because each subsystem will be protected from the effects of changes imposed on the other subsystems as a result of changing business conditions.

In what follows, we will discuss how the above criteria can be used as a guide in the construction of information subsystems for business organizations. The analysis will focus on the process data creation and/or usage criterion because it constitutes the crux of the problem, in the sense that the subsystems are primarily based on this criterion.

Strong Components Procedure

We now discuss the construction of the subsystems using some concepts from graph theory [See 2]. We define the following terms,

$A_u = (a_{ij})$ is the Data vs Process usage matrix

$$\text{where } a_{ij} = \begin{cases} 1 \text{ if data } d_i \text{ is used by process } p_j \\ 0 \quad \text{Otherwise} \end{cases}$$

$A_c = (a'_{ij})$ is the Data vs Process creation matrix

$$\text{where } a'_{ij} = \begin{cases} 1 \text{ if data } d_i \text{ is created/derived} \\ \quad \text{by process } p_j \\ 0 \quad \text{Otherwise} \end{cases}$$

The Adjacency/path matrix G is defined to be

$$G = (g_{ij}) \text{ where } g_{ij} = \begin{cases} 1 \quad \text{If process (data) i} \\ \quad \text{interacts with} \\ \quad \text{process (data) j} \\ 0 \quad \text{Otherwise.} \end{cases}$$

with $G_p = A_c^T A_u$ for Process vs Process matrix

and $G_D = A_u A_c^T$ for Data vs Data matrix

and A_c^T is the transpose of A_c matrix

The Reachability matrix R is defined to be

$$R = (r_{ij}) \text{ where } r_{ij} = \begin{cases} 1 \text{ if process (data) j} \\ \quad \text{is reachable from} \\ \quad \text{process (data) i.} \\ 0 \quad \text{Otherwise.} \end{cases}$$

with $R(i) = \{i\} \cup \Gamma(i) \cup \Gamma^2(i) \cup \ldots \cup \Gamma^k(i)$

where $\Gamma(i)$ denotes a mapping of process(data) i

in $G_p(G_D)$ into $G_p(G_D)$.

and R_p denotes process to process reachability

R_D denotes data to data reachability.

The Reaching matrix Q is defined to be

$$Q = (q_{ij}) \text{ where } q_{ij} = \begin{cases} 1 & \text{If process (data) j can reach process (data) i} \\ 0 & \text{Otherwise.} \end{cases}$$

and $Q = R^T$ i.e. the transpose of the R matrix.

As stated earlier, we are interested in knowing which business functions or processes strongly interact with each other by the creation and/or usage of common data. In the case of data, knowing which data are strongly connected with the same process will have a significant effect on how the data is organized for processing by the various subsystems. In graph theoretical terms, we are interested in computing the strong component SC of the matrices G_p and G_D respectively. That is, we want to find all submatrices of the adjacency matrix which have every two processes (or data) mutually reachable through data (or process).

The strong component matrix SC is defined to be a maximal strongly connected submatrix of G the adjacency matrix. That is, strong component matrix identifies all the submatrices of the adjacency matrix G which have every two points mutually reachable. In mathematical notation, SC is defined as:

$SC_p = R_p \times Q_p$ for process

$$SC_D = R_D \times Q_D \text{ for data}$$

where the operator x denotes element-by-element multiplication of the matrices R and Q respectively. For SC_p, each pair of processes is mutually reachable through a data class.

We now describe the procedure for calculating the strong component SC of the processes and data from the adjacency matrices G_p and G_D given A_u (the data vs. process usage matrix) and A_c (the data vs. process creation matrix).

I) Compute the adjacency matrix G_p, G_D from A_u and A_c^T using the relation:

$$G_p = A_c^T A_u$$

and $G_D = A_u A_c^T$

II) Construct the reachability matrix R_p (R_D) from G_p (G_D) using the relation

$$R_p(i) = \{i\} \cup \Gamma_p(i) \cup \Gamma_p^2(i) \cup \ldots \cup \Gamma_p^k(i)$$

and $R_D(i) = \{i\} \cup \Gamma_D(i) \cup \Gamma_D^2(i) \cup \ldots \cup \Gamma_D^k(i)$.

And the union operations on the $\Gamma(i)$ are performed from left to right until the current total set is not increased in size by the addition of any new members from the next union.

III) Construct the reaching matrices Q_p, Q_D from R_p and R_D respectively by using the relation

$$Q_p = R_p^T \text{ and } Q_D = R_D^T$$

IV) Compute the strong components SC_p, SC_D for the process and data respectively from the relation

$$SC_p = R_p \times Q_p \text{ for process}$$

$$\text{and } SC_D = R_D \times Q_D \text{ for data}$$

CALCULATION OF STRONG COMPONENTS: An Example

We now illustrate, with sample data taken from the BSP manual [1], how to compute the strong components of a set of business processes using the data vs. process matrices.

The data vs. process usage matrix A_u and the data vs. process creation matrix A_c are as indicated in Figures 1 and 2. From the two matrices A_u and A_c we compute the adjacency matrix G_p (Figure 3), using the relationship stated in Step I of the procedure. The reachability R_p and reaching Q_p matrices are computed from Steps II and III respectively. The resulting matrices are as shown in Figures 4 and 5. Finally step IV calculates the strong components for the processes (Figure 6) using the reachability R_p and reaching Q_p matrices. The strong components for the set of business data classes can similarly be calculated using the same data vs. process matrices A_u and A_c.

As shown in Figure 6, the strong components procedure will usually not

result in a complete decomposition of the business' information system. However, it serves as a good starting point to proceed with the decomposition, taking into account the other criteria discussed earlier. Typically the SC procedure may provide two or more subsystems with the other business functions or processes indicated as being somewhat independent of the subsystems.

If the subsystems identified meet the comprehensibility criterion, then they can be accepted without further modifications. However, if any subsystem is judged to be either too large or small then the following might be done.

a) If the subsystem is too large, then further decomposition might be undertaken, bearing in mind the data usage and/or creation criterion so that inclusion of unneeded data may not create dependencies among what logically should be separate subsystems [6].

b) On the other hand, if the subsystem is considered to be too small to be realized as one unit, then it may be combined with other small subsystems which are connected together in terms of either using or creating common data. In this way, some economies of scale may be realized and there will not be a proliferation of small subsystems comprising the organization's information system.

c) However, if none of the subsystems is either too large or too small, so that one is presented with a number of business functions which are independent of each other by the SC procedure, then one must find an

alternative procedure to group those processes or functions which together or in combination with other already identified subsystems can constitute a major subsystem of the information system. This last point leads us directly into a discussion of the path enumeration procedure.

PATH ENUMERATION PROCEDURE

This procedure can be used in conjunction with the SC procedure to determine the composition of the subsystems and is based on the actual paths generated by each business function or process. We consider a path in this discussion to be a directed graph with three vertices and having the following characteristics;

1) The initial and final vertices are processes, and
2) The intermediate vertex is a data class.

Graphically, a path can be represented as below;

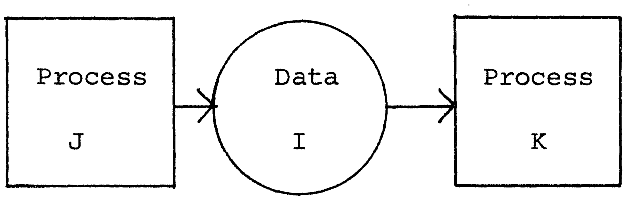

Figure 1

The difference between the two procedures is that while the SC case is based only on the <u>existence</u> of a path without specifying which path it is, the second procedure <u>enumerates</u> all the paths generated by any process or function. Therefore, this procedure is more precise. The paths thus

generated are used as a basis for determining which processes or functions may be grouped together to constitute a single subsystem or be made part of an existing subsystem identified by the SC procedure. The path enumeration procedure works as follows:

I) Compute the expression $A_c^T A_u = \sum_i a'_{ji} a_{ik}$ and enumerate all the paths generated by process p_j to process p_k through common data d_i.

II) For any process p_j, find all processes p_k's which are connected to p_j through common data d_i, then group all such processes p_j's and p_k's together.

III) If any process p_j or P_k is already included in any subsystem specified earlier using the SC procedure, then the other process p_k or p_j can be made a member of that subsystem by virtue of its association with the process p_j or p_k through common link with data d_i.

IV) If all the processses p_j and p_k which share a common link with data d_i are not members of any subsystem identified earlier, then they can be grouped together to constitute a subsystem provided none of the stated criteria is violated.

V) However, if the processes p_j and p_k linked by common data d_i cannot together constitute a new subsystem without violating any of the stated criteria, then the processes p_j and p_k may be included in any subsystem which in the judgement of the analyst may be closely connected with those processes. Once again the comprehensibility criterion must be

judiciously observed so one would not end up with subsystems which are too large to comprehend in a reasonable time frame.

Whatever the final composition of the subsystems may be we should bear in mind that they should transcend organizational boundaries. This is because organizational units in business are known to change from time to time. Hence to construct information subsystems along organizational lines will seriously violate the flexibility criterion which demands each subsystem be stable as it responds to changing business conditions.

SUBSYSTEMS CONSTRUCTION: AN EXAMPLE

We now illustrate with an example how the various subsystems of an information system can be constructed using the strong component and the path enumeration procedures. The results of the SC analysis given in figure 6 indicate the following groups of processes may each constitute a subsystem, due to the interconnections existing among them. Subsystem 1 includes the processes 8, 9, 10, 18, 21 and 24. And subsystem 2 may include the processes 13, 14, 15 and 17.

We now need to determine with the aid of the path enumeration procedure into which subsystems the other remaining processes may be classified.

The results of the path enumeration procedure show that certain processes do not originate a path, that is, do not create data which is subsequently used by some other process. These processes are 2, 3, 6, 7, 11, 20, 22, 23, 25,

27 and 28. However, each of the remaining processes 1, 4, 5, 12, 16, 19 and 26 is the origin of one or more paths or the 'root' of a 'tree'. The paths generated by each of these processes are as shown in Figure 7a-7g.

Processes 1 and 4 of Figures 7a and 7b are linked to processes 2 and 3 through data 1. But processes 1 and 4 are also linked by data 2 to process 5 (Figure 7c). Hence we can group processes 1, 2, 3, 4 and 5 together to constitute a third subsystem.

Figure 7e indicates process 16 is connected to processes 15 and 17 by data 12. But processes 15 and 17 are already members of the second subsystem obtained through the SC procedure. Hence process 16 automatically becomes a member of that subsystem. Also Figure 7d shows that process 12 is connected to processes 11 and 22 through data 7 and 8 respectively. However processes 11, 12 and 22 together cannot constitute one subsystem because of its small size, but they can be included in the second subsystem because they are closely connected to it. So that the composition of the second subsystem will include processes 11, 12, 13, 14, 15, 16, 17 and 22.

It can be observed from Figure 7f, that process 19 is connected to processes 6, 7 and 20 by data 15. But none of the four processes is a member of any previously identified subsystem, hence they can be grouped together to form the nucleus of a new subsystem. However, process 7 is connected to process 25 through common usage of data 1 (Figures 7a and 7b). Process 25 in turn is also connected to process 23 through common usage of data 2 (Figure 7c). Thus it is logical to group processes 7, 23, and 25 together. But because process 7 is already a member of subsystem four, processes 23 and 25

can be included in that subsystem also. Hence the full composition of subsystem four will comprise the following processes 6, 7, 19, 20, 23 and 25. The only processes which are not included in any subsystem thus far are 26, 27 and 28. These processes together actually constitute a fifth subsystem because process 26 is connected to processes 27 and 28 by data 18 (Figure 7g). The final composition of each subsystem is as shown below.

Subsystem I, which may be named Product Requirements, comprises processes 8, 9, 10, 18, 21 and 24.

Subsystem II or Product Manufacturing comprises processes 11, 12, 13, 14, 15, 16, 17 and 22.

Subsystem III or Management Control comprises processes 1, 2, 3, 4 and 5.

Subsystem IV or Marketing comprises processes 6, 7, 19, 20, 23 and 25.

Subsystem V or Personnel also comprises processes 26, 27 and 28.

It is apparent from the composition of the final subsystems, that the decomposition transcends organizational boundaries thus meeting the flexibility criterion. The second and third criteria, that is the separability and comprehensibility criteria, ensure that each subsystem is of a manageable size and somewhat independent from the others in the sense that each process is a member of one and only one subsystem. The fourth or integrability criterion is needed to ensure that the information subsystems can be fully integrated together to form the information system of the

business. For example, subsystem III, management control, can be integrated with subsystem V which is Personnel because of the common link or interface provided by processes 5 and 26 through data 2. Similarly Subsystem III can be integrated with Subsystem IV because of the common link or interface afforded by processes 1, 4 and 5 together on one hand and process 25 on the other through data 1 and 2. Similar connections or interfaces can be found for the other subsystems such that a fully integrated information systems architecture can be achieved when all the subsystems are analyzed. Figure 8 illustrates how the five subsystems can be integrated together to form the total information system of the business.

It is necessary to emphasize that the information subsystems identified from the analysis do not constitute the final program modules for the business or enterprise. Each information subsystem may require a certain number of program modules for it to be fully realized. The number of program modules will depend on several factors including the size and the degree of interaction of the subsystems.

Conclusion

We have discussed in the preceding sections the need to formalize the way information systems are grouped into subsystems in a BSP study. We have provided five main criteria or guidelines which can aid information systems designers to develop integrated and stable information systems. Two procedures - strong component analysis and path enumeration - which can be used with minimal personal judgement on the part of the analysts have been described and their use illustrated with sample data taken from the BSP

manual.

The advantage of this method of subsystem identification or construction is in the elimination of the manual tedious process involved in the BSP approach. The procedure can be automated thus saving analyst time and allowing more complete analyses than might be undertaken during a manual analysis. This methodology will also contribute towards stable information systems because each subsystem will be capable of responding to changing business conditions without having an adverse effect on the other subsystems not affected by the change. Each subsystem will not only be of a manageable size so that it can be well studied and comprehended, but the components of each subsystem will also be separate and unique from the other subsystems. Also the ability to clearly specify the interfaces between any pair of subsystems will promote a clearer understanding of the whole information system. Finally no unnecessary dependence will be created among subsystems which should otherwise be logically unrelated through the inclusion of unneeded data. This proposed procedure improves the likelihood that all data will be considered in the construction of the information systems architecture.

ACKNOWLEDGEMENT

I am especially indebted to Rita Summers for her insightful comments and suggestions which have greatly improved the quality of the paper. I am also grateful to J. Gene Sakamoto for helpful discussions during the course of this research. APL programs implementing the procedures presented in this paper were written with the assistance of Funn Young. Financial support for the work was provided by the Advance Tech. group in DPMG.

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DATA-PROCESS USAGE MATRIX

DATA \ PROCESS	Business Planning	Org. Analysis	Review & Control	Financial Plan.	Capital Acquisit.	Research	Forecasting	Design & Develop.	Prod. Spec. Maint.	Purchasing	Receiving	Inventory Control	Workflow Layout	Scheduling	Capacity Plan.	Material Reqmts.	Operations	Territory Mgmt.	Selling	Sales Admin.	Order Servicing	Shipping	General Acct.	Cost Planning	Budget Acct.	Personnel Plan.	Recruit Develop.	Compensation
Planning		1	1				1																		1			
Financial	1		1	1																			1		1	1		1
Product						1	1		1				1	1		1		1	1		1	1						
Parts Master																												
Bill of Material								1								1												
Vendor									1		1			1	1	1							1	1				
Raw Material Inv.											1																	
Fin. Goods Inv.																						1						
Facilities														1	1													
Work in Progress					1							1					1									1		
Machine Load														1			1											
Open Reqmts.															1		1											
Routings													1		1													
Customer							1	1											1		1		1					
Sales Territory						1	1													1								
Order																		1	1	1		1		1				
Cost	1									1															1			
Employee					1																		1		1		1	1

Fig. 1

DATA-PROCESS CREATION MATRIX

PROCESS / DATA	Business Planning	Org. Analysis	Review & Control	Financial Plan.	Capital Acquisit.	Research	Forecasting	Design & Develop.	Prod. Spec. Maint.	Purchasing	Receiving	Inventory Control	Workflow Layout	Scheduling	Capacity Plan.	Material Reqmts.	Operations	Territory Mgmt.	Selling	Sales Admin.	Order Servicing	Shipping	General Acct.	Cost Planning	Budget Acct.	Personnel Plan.	Recruit Develop.	Compensation
Planning	1			1																								
Financial					1																							
Product								1																				
Parts Master								1	1																			
Bill of Material									1																			
Vendor										1																		
Raw Material Inv.												1																
Fin. Goods Inv.												1																
Facilities													1															
Work in Progress														1														
Machine Load															1													
Open Reqmts.																1												
Routings																	1											
Customer																		1										
Sales Territory																			1									
Order																					1							
Cost																								1				
Employee																										1		

Fig. 2

THE ADJACENCY/PATH MATRIX G

PROCESS \ PROCESS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1. Business Plan.		1	1				1																		1			
2. Org. Analysis																												
3. Review & Control																												
4. Financial Plan		1	1				1																		1			
5. Capital Acquis.	1		1	1																			1		1	1		1
6. Research																												
7. Forecasting																												
8. Design & Develop.						1	1		1			1	1			1		1	1		1	1						
9. Prod. Spec. Maint.								1								1												
10. Purchasing									1		1			1	1	1							1	1				
11. Receiving																												
12. Inventory Control											1											1						
13. Workflow Layout														1	1													
14. Scheduling				1								1					1								1			
15. Capacity Plan.														1			1											
16. Material Reqmts.															1		1											
17. Operations													1		1													
18. Territory Mgmt.							1	1	1										1		1		1					
19. Selling							1	1												1								
20. Sales Admin.																		1	1	1		1		1				
21. Order Servicing																												
22. Shipping																												
23. Gen. Accounting																												
24. Cost Planning	1									1															1			
25. Budget Account																												
26. Personnel Plan.				1																			1		1		1	1
27. Recruit Develop																												
28. Compensation																												

Fig. 3

THE REACHABILITY MATRIX R_p

PROCESS PROCESS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1. Business Plan.	1																											
2. Org. Analysis		1																										
3. Review & Control			1																									
4. Financial Plan				1																								
5. Capital Acquis.		1	1	1	1		1																1		1		1	1
6. Research						1																						
7. Forecasting							1																					
8. Design & Develop.	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
9. Prod. Spec. Maint.	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
10. Purchasing	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
11. Receiving											1																	
12. Inventory Control												1																
13. Workflow Layout		1	1	1			1				1	1	1	1	1		1					1			1			
14. Scheduling		1	1	1			1				1	1	1	1	1		1					1			1			
15. Capacity Plan.		1	1	1			1				1	1	1	1	1		1					1			1			
16. Material Reqmts.		1	1	1			1				1	1	1	1	1	1	1					1			1			
17. Operations		1	1	1			1				1	1	1	1	1		1					1			1			
18. Territory Mgmt.	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
19. Selling																			1									
20. Sales Admin.																				1								
21. Order Servicing	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
22. Shipping																						1						
23. Gen. Accounting																							1					
24. Cost Planning	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
25. Budget Account																									1			
26. Personnel Plan.		1	1				1																		1	1		
27. Recruit Develop.																											1	
28. Compensation																												1

Fig. 4

THE REACHING MATRIX Q_p

PROCESS / PROCESS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1. Business Plan.	1							1	1	1								1			1			1				
2. Org. Analysis		1			1			1	1	1			1	1	1	1	1	1			1			1		1		
3. Review & Control			1		1			1	1	1			1	1	1	1	1	1			1			1		1		
4. Financial Plan				1	1			1	1	1			1	1	1	1	1	1			1			1				
5. Capital Acquis.					1																							
6. Research						1		1	1	1								1			1			1				
7. Forecasting					1		1	1	1	1			1	1	1	1	1	1			1			1		1		
8. Design & Develop.								1	1	1								1			1			1				
9. Prod. Spec. Maint.								1	1	1								1			1			1				
10. Purchasing								1	1	1								1			1			1				
11. Receiving								1	1	1	1		1	1	1	1	1	1			1			1				
12. Inventory Control								1	1	1		1	1	1	1	1	1	1			1			1				
13. Workflow Layout								1	1	1			1	1	1	1	1	1			1			1				
14. Scheduling								1	1	1			1	1	1	1	1	1			1			1				
15. Capacity Plan.								1	1	1			1	1	1	1	1	1			1			1				
16. Material Reqmts.								1	1	1						1		1			1			1				
17. Operations								1	1	1			1	1	1	1	1	1			1			1				
18. Territory Mgmt.								1	1	1								1			1			1				
19. Selling								1	1	1								1	1		1			1				
20. Sales Admin.								1	1	1								1		1	1			1				
21. Order Servicing								1	1	1								1			1			1				
22. Shipping								1	1	1			1	1	1	1	1	1			1	1		1				
23. Gen. Accounting					1			1	1	1								1			1		1	1				
24. Cost Planning								1	1	1								1			1			1				
25. Budget Account					1			1	1	1			1	1	1	1	1	1			1			1	1	1		
26. Personnel Plan.																										1		
27. Recruit Develop					1																						1	
28. Compensation					1																							1

Fig. 5

PROCESS STRONG COMPONENT/INTERACTION MATRIX SC

PROCESS PROCESS	8	9	10	18	21	24	13	14	15	17	1	2	3	4	5	6	7	11	12	16	19	20	22	23	25	26	27	28
8. Design & Develop	1	1	1	1	1	1																						
9. Prod. Spec. & Maint.	1	1	1	1	1	1																						
10. Purchasing	1	1	1	1	1	1																						
18. Territory Mgmt.	1	1	1	1	1	1																						
21. Order Servicing	1	1	1	1	1	1																						
24. Cost Planning	1	1	1	1	1	1																						
13. Workflow Layout							1	1	1	1																		
14. Scheduling							1	1	1	1																		
15. Capacity Plan.							1	1	1	1																		
17. Operations							1	1	1	1																		
1. Business Plan.											1																	
2. Org. Analysis												1																
3. Review & Control													1															
4. Financial Plan.														1														
5. Capital Acquisit.															1													
6. Research																1												
7. Forecasting																	1											
11. Receiving																		1										
12. Inventory Control																			1									
16. Material Reqmts.																				1								
19. Selling																					1							
20. Sales Administ.																						1						
22. Shipping																							1					
23. Gen. Accounting																								1				
25. Budget Account																									1			
26. Personnel Plan.																										1		
27. Recruit Develop.																											1	
28. Compensation																												1

Fig. 6

PROCESS DATA INTERACTION PATH

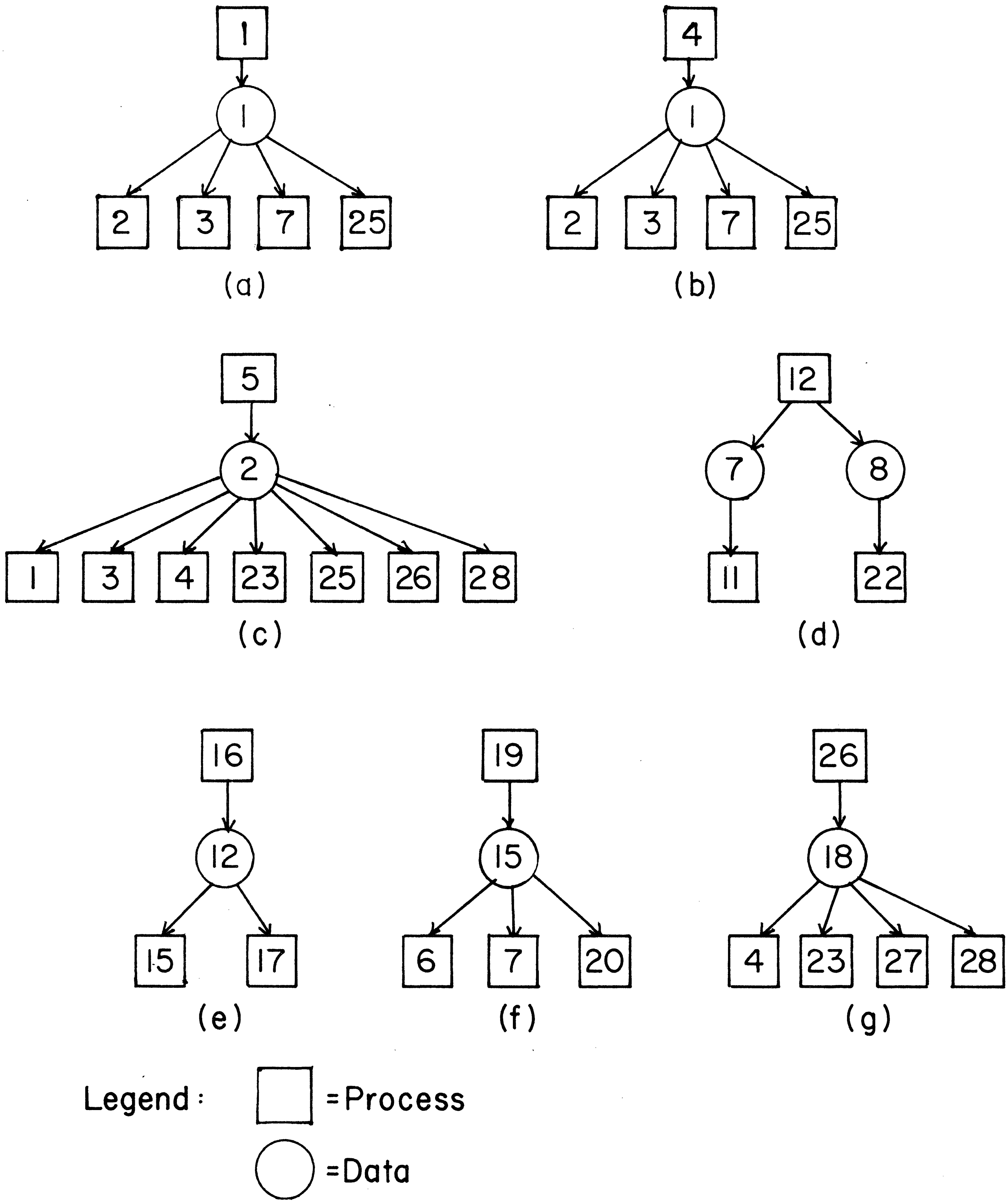

Fig. 7

INFORMATION SUBSYSTEMS

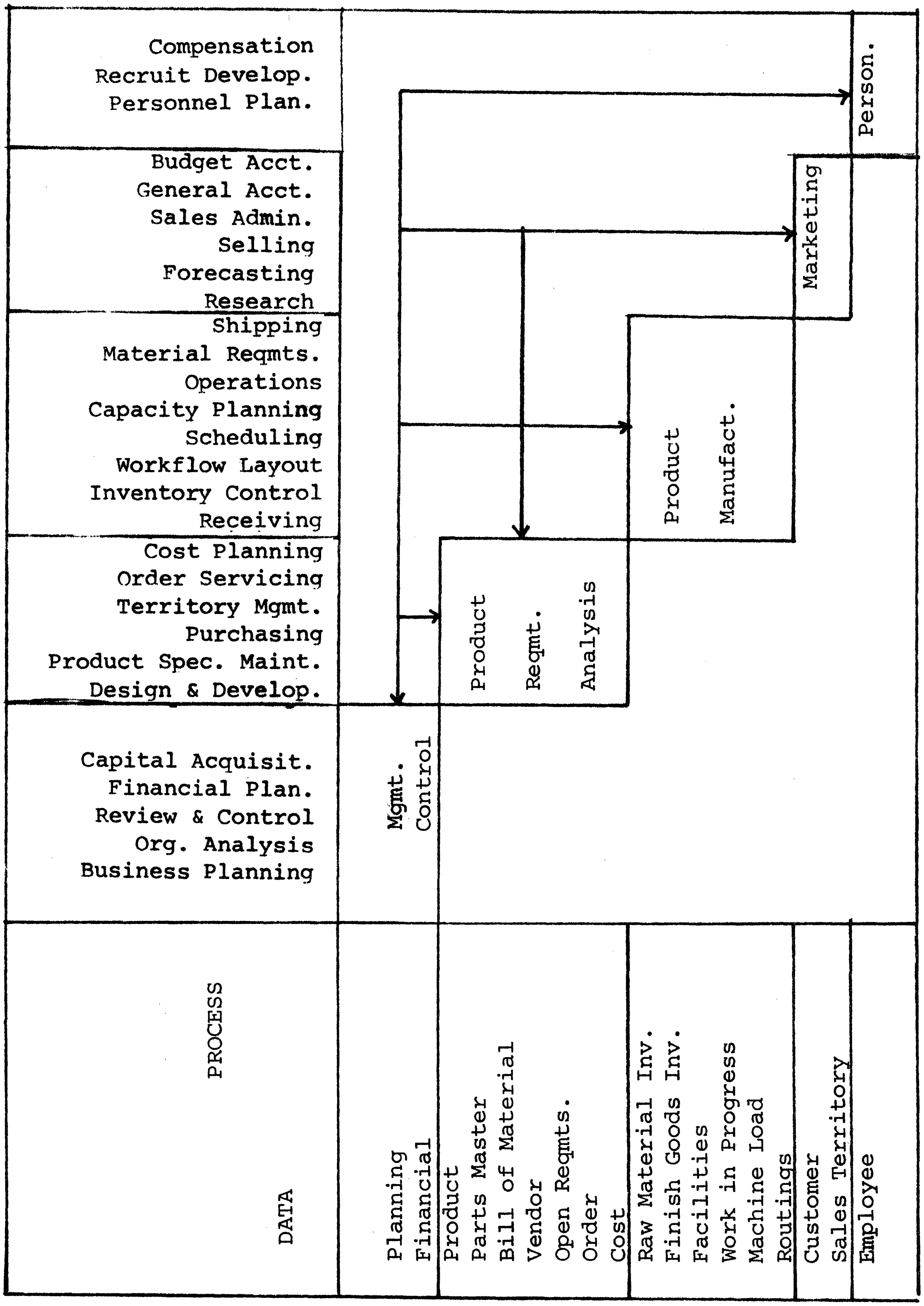

Fig. 8

SCIENTIFIC CENTER REPORT INDEXING INFORMATION

1. AUTHOR(S) :
Kweku Ewusi-Mensah

2. TITLE : Criteria for Decomposing an Information System into its Subsystems for Business Systems Planning

3. ORIGINATING DEPARTMENT
Los Angeles Scientific Center

4. REPORT NUMBER
G320-2702

5a. NUMBER OF PAGES
26

5b. NUMBER OF REFERENCES
6

6a. DATE COMPLETED
March 1979

6b. DATE OF INITIAL PRINTING
March 1980

6c. DATE OF LAST PRINTING

9. SUBJECT INDEX TERMS
Information Systems
Business Systems Planning
Flexibility
Separability
Comprehensibility
Integrability
Data/Process

7. ABSTRACT :

The paper discusses five main criteria for the construction of the subsystems of an information system, for business systems planning. They are flexibility, separability, comprehensibility, integrability and data usage and/or creation. Two procedures are described based on the data usage and/or creation criterion which can be used to determine the composition of each subsystem, keeping the other four criteria in focus. An application of the methodology to a sample of BSP data is discussed.

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